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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte YASUYUKI KII

Appeal 2009-007253
Application 10/797,743[1]
Technology Center 2600

Before MARC S. HOFF, CARLA M. KRIVAK,
and CARL W. WHITEHEAD, JR., *Administrative Patent Judges*.

HOFF, *Administrative Patent Judge*.

DECISION ON APPEAL[2]

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[1] The real party in interest is Sharp Kabushiki Kaisha.

[2] The two month time period for filing an appeal or commencing a civil action, as recited in 37 C.F.R. § 1.304 or for filing a request for rehearing as recited in 37 C.F.R. § 41.52, begins to run from the "MAIL DATE" (paper delivery mode) or the "NOTIFICATION DATE" (electronic delivery mode) shown on the PTOL-90A cover letter attached to this decision.

STATEMENT OF THE CASE

Appellant appeals under 35 U.S.C. § 134(a) from a Final Rejection of claims 1-11. We have jurisdiction under 35 U.S.C. § 6(b).

We affirm.

Appellant's invention relates to a graphic processing apparatus and method for providing shadowing of three-dimensional objects that eliminates unintentional shadowing of edge portions of shadow polygons due to errors in coordinate conversion calculated values (Abstract). The graphic process is completed in three stages: a visual-point coordinate conversion process, a hidden surface removal process, and a shadow process. Specifically, a visual-point coordinate conversion processing unit 1 converts normal polygons representing the three-dimensional object(s) and shadow polygons representing a shadow volume into visual-point coordinates including x-coordinates and y-coordinates and depth values (Fig. 1; Spec. 9:15–10:1; ¶ [0078]). The visual point coordinates and depth values of the shadow polygons are sorted into front-facing shadow polygons and back-facing shadow polygons (Spec. 10:2-6). A calculation section 5 performs hidden surface removal processing on the normal polygons based upon the visual-point coordinates and depth values (Abstract; Fig. 1). Accordingly, pixel memory 6 and a Z-buffer memory 7 are updated with any modification to the values (Abstract; Fig. 1). Based upon a comparison of the depth values for each polygon and Z values stored in the Z-buffer memory 7, shadow processing is conducted only on a coordinate region positioned in front of back-facing shadow polygons and behind front-facing shadow polygons (Abstract; Fig. 1). After the shadow processing is performed, pixel memory 6 is updated (Abstract).

Claim 1 is exemplary:

1. A graphic processing apparatus having a Z-buffer memory storing a Z value representing a depth of a display object when seen from a visual point per pixel and a pixel memory storing color data on each pixel for creating an image of a shadowed three-dimensional object having a shadow produced by obstructing a ray of light from a light source by the three-dimensional object, comprising:

a visual-point coordinate conversion processing section for upon input of graphic data on normal polygons constituting each object including the three-dimensional object and on shadow polygons constituting a shadow volume that defines a shadow space produced by obstructing the ray of light from the light source by the three-dimensional object, converting the graphic data to visual-point coordinates including x-coordinates and y-coordinates and depth values, and outputting the obtained visual-point coordinates and depth values in a state of being sorted into those of front-facing shadow polygons that face front, those of back-facing shadow polygons that face back when seen from the visual point, and those of the normal polygons; and

a hidden surface removal and shadowing processing section for obtaining a coordinate region that is positioned behind the front-facing shadow polygons and in front of the back-facing shadow polygons when seen from the visual point based on the visual-point coordinates, the depth values and the Z-buffer memory after hidden surface removal processing by Z-buffer method is performed on the normal polygons, and updating color data on pixels in the pixel memory corresponding to the obtained coordinate region to shadow color data.

The prior art relied upon by the Examiner in rejecting the claims on appeal is:

Kelley	US 5,517,603	May 14, 1996
Takeuchi	US 6,402,615 B1	Jun. 11, 2002
Shimizu	US 6,744,430 B1	Jun. 1, 2004 (filed Jul. 20, 2000)

Claims 1, 3, 4, 6, and 9-11 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Shimizu.

Claims 2 and 5 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Shimizu in view of Kelley.

Claims 7 and 8 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Shimizu in view of Takeuchi.

ISSUE

Appellant contends that Shimizu does not disclose performing hidden surface removal and shadow processing in order to obtain a coordinate region "positioned behind the front-facing shadow polygons and in front of the back-facing shadow polygons," as claimed (App. Br. 7). Appellant asserts that the "'layer by layer' approach to outputting polygon IDs, as disclosed in Shimizu, does not teach or suggest the Appellant's claimed coordinate region 'positioned behind the front-facing shadow polygons and in front of the back-facing shadow polygons'" and that the claims "do not require 'layer by layer' processing" (App. Br. 7). Appellant argues that the Examiner has used impermissible hindsight reasoning since there is no support in Shimizu that "'if a polygon is inside a volume, then it is behind the front facing shadow polygons and in front of the back facing shadow polygons relative to a viewpoint, and vice versa'" (App. Br. 8 (quoting Final Office Action 14)).

Appellant's contentions present us with the following dispositive issue: Do the references disclose a graphic processing apparatus that includes:

> a hidden surface removal and shadowing processing section for obtaining a coordinate region that is positioned behind the front-facing shadow polygons and in front of the back-facing shadow polygons when seen from the visual point based on the visual-point coordinates, the depth values and the Z-buffer memory after hidden surface removal processing by Z-buffer method is performed on the normal polygons, and updating color data on pixels in the pixel memory corresponding to the obtained coordinate region to shadow color data (claim 1)?

FINDINGS OF FACT

The following Findings of Fact (FF) are shown by a preponderance of the evidence.

Invention

1. A shadow volume defines a shadow space produced by a ray of light from a light source being obstructed by an object. The shadow volume is bounded by the front-facing shadow polygon(s) (CBFG and AEFB) and the back-facing shadow polygon(s) (AEGC) (Fig. 12; ¶ [0006]-[0007];Spec. 5:14-16).

Shimizu

2. Shimizu discloses that when an opaque polygon 91 is positioned in the foreground and another opaque polygon 92 is positioned behind polygon 91, intercepting area 93 is not delineated since it will not be seen from the viewpoint of an observer (Fig. 15A; col. 12, ll. 64-66).

3. Shimizu discloses an attribute alteration unit 76 that performs processing for decision volumes such as shadow volumes and modifier volumes. Specifically, "Dijon volume processing determines whether a subject polygon is inside or outside of a [sic] shadow volume polygons or

modifier volume polygons" (Figs. 22, 24; col. 17, ll. 9-14). One embodiment of the attribute alteration unit includes region buffers 130-1 to 130-n that store information regarding whether pixel data corresponding to a subject polygon is inside or outside of a volume (region), pixel by pixel (Fig. 24; col. 18, ll. 10-12, 49-51).

4. Shimizu discloses a geometry block 63 that converts polygon data PD1 from a three-dimensional world coordinate system to polygon data PD2 in a two-dimensional screen coordinate system (Fig. 10; col. 10, ll. 45-50). Polygon data PD2 is supplied to pixel data generator 64 for further conversion to pixel data PD3 using fractal processing or raster scan processing (Fig. 10; col. 11, ll. 8-10). A pixel sorter 65 rearranges the pixel data in Z value order, where the pixel data includes the polygon ID, polygon attribute information, screen coordinates (Sx, Sy), Z values, color information (R, G, B, a value), texture IDs, texture coordinates (Tx, Ty), and level of detail (LOD) offset values (Figs. 10, 13; col. 11, ll. 25-36).

5. Shimizu discloses that since polygon C is on the inside of volume A defined by a front-facing polygon a1 ("front surface") and back-facing polygon a2 ("back surface"), the light volume with respect to shadow processing of relevant pixels is invalidated (Fig. 26A; col. 20, ll. 6-12; col. 22, ll. 4, 31, 56-59)

PRINCIPLES OF LAW

Anticipation

Anticipation pursuant to 35 U.S.C. § 102 is established when a single prior art reference discloses expressly or under the principles of inherency each and every limitation of the claimed invention. *Atlas Powder Co. v.*

IRECO, Inc., 190 F.3d 1342, 1347 (Fed. Cir. 1999); *In re Paulsen*, 30 F.3d 1475, 1478-79 (Fed. Cir. 1994).

Analysis of whether a claim is patentable over the prior art under 35 U.S.C. § 102 begins with a determination of the scope of the claim. We determine the scope of the claims in patent applications not solely on the basis of the claim language, but upon giving claims their broadest reasonable construction in light of the specification as it would be interpreted by one of ordinary skill in the art. *In re Am. Acad. of Sci. Tech Ctr.*, 367 F.3d 1359, 1364 (Fed. Cir. 2004). The properly interpreted claim must then be compared with the prior art.

Obviousness

On the issue of obviousness, the Supreme Court has stated that "[t]he obviousness analysis cannot be confined by a formalistic conception of the words teaching, suggestion, and motivation." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 419 (2007). Further, the Court stated "[t]he combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results." *Id.* at 416.

ANALYSIS

Claims 1, 3, 4, 6, and 9-11

We select claim 1 as representative of this group of claims, pursuant to our authority under 37 C.F.R. § 41.37(c)(1)(vii).

Representative claim 1 recites a graphic processing apparatus that includes

> a hidden surface removal and shadowing processing section for obtaining a coordinate region that is positioned behind the front-facing shadow polygons and in front of the

> back-facing shadow polygons when seen from the visual point based on the visual-point coordinates, the depth values and the Z-buffer memory after hidden surface removal processing by Z-buffer method is performed on the normal polygons, and updating color data on pixels in the pixel memory corresponding to the obtained coordinate region to shadow color data.

Independent claims 4 and 9 contain claim limitations similar in scope.

We do not consider Appellant's arguments to be persuasive to show Examiner error. We agree with the Examiner's finding that Shimizu discloses a "hidden surface removal processing" where "area 93 of the opaque polygon 92 is not delineated, so that it will not be seen from the view point of an observer" (Ans. 18; FF 2). Specifically, Shimizu discloses that when an opaque polygon 91 is positioned in the foreground and another opaque polygon 92 is positioned behind polygon 91, intercepting area 93 is not delineated since it will not be seen from the viewpoint of an observer (FF 2). Therefore, Shimizu discloses that specific overlapping regions of an object are removed when they are hidden from visual point of the observer (FF 2).

We also agree with the Examiner's finding that Shimizu discloses shadow processing where the "coordinate region that is positioned behind the front-facing shadow polygons and in front of the back-facing shadow polygons when seen from the visual point based on the visual-point coordinates" is the region that is subjected to shadow processing as claimed (Ans. 6-7). Shimizu discloses an attribute alteration unit 76 that performs processing for decision volumes such as shadow volumes and modifier volumes (FF 3). Specifically, Dijon volume processing determines whether a subject polygon is *inside or outside of a shadow volume* polygons or

modifier volume (polygons) (FF 3). One embodiment of attribute alteration unit 76 includes region buffers 130-1 to 130-n that store information as to whether pixel data corresponding to the subject polygon is inside or outside a volume (region), pixel by pixel (FF 3). By definition, shadow volume defines a shadow space produced by a ray of light from a light source being obstructed by an object (FF 1). The shadow volume is *bounded by front-facing and back-facing shadow polygons* (FF 1). Therefore, we agree with the Examiner that if a polygon is within the shadow volume, "it is behind the front-facing shadow polygons and in front of the back-facing shadow polygons relative to a viewpoint, and vice versa" (Ans. 6-7).

Regarding the coordinate region determination, we agree with the Examiner's finding that Shimizu discloses that the region of "relevant pixels" is defined by the screen coordinates (x, y) that indicate positions on the display screen (Ans. 19 (May 28, 2008); FF 4). Shimizu discloses a geometry block 63 that converts polygon data PD1 from a three-dimensional world coordinate system to polygon data PD2 in a two-dimensional screen coordinate system (FF 4). Polygon data PD2 is supplied to pixel data generator 64 for further conversion to pixel data PD3 using fractal processing or raster scan processing (FF 4). A pixel sorter 65 that rearranges the pixel data in Z value order, where the pixel data includes the polygon ID, polygon attribute information, screen coordinates (Sx, Sy), Z values, color information (R, G, B, a value), texture IDs, texture coordinates (Tx, Ty), and level of detail (LOD) offset values (FF 4). The screen coordinates (Sx, Sy) correspond to the coordinate region determination. We agree with the Examiner's finding that Shimizu discloses that a coordinate region is obtained for polygon C which is inside of volume A defined by front-facing

polygon a1 and back-facing polygon a2 (FF 5). Shimizu discloses that, when a subject polygon is inside of a volume, the light with respect to shadow processing of relevant pixels is invalidated (FF 5).

With respect to the layer-by-layer approach, we agree that although the claimed invention does not require a layer-by-layer approach, the claim limitations do not exclude the layer-by-layer approach (Ans. 16-17). As such, we find that Appellant's argument that Shimizu's layer-by-layer approach to outputting polygon IDs does not teach or suggest Appellant's claimed coordinate region positioning (App. Br. 7) is not commensurate with the scope of the claims.

Therefore, we find that Shimizu teaches a graphic processing apparatus recited in claim 1. As a result, we will sustain the Examiner's § 102 rejection of representative claim 1 and that of claims 3, 4, 6, and 9-11.

Claims 2 and 5

Appellant presents no separate argument for the patentability of dependent claims 2 and 5, which depend from claims 1 and 4, respectively. We therefore affirm the rejection of claims 2 and 5 under 35 U.S.C. § 103 as unpatentable over Shimizu in view of Kelley for the same reasons expressed *supra* with respect to parent claims 1 and 4.

Claims 7 and 8

Appellant presents no separate argument for the patentability of dependent claims 7 and 8, which depend from claim 4. We therefore affirm the rejection of claims 7 and 8 under 35 U.S.C. § 103 as be unpatentable over Shimizu in view of Takeuchi for the same reasons expressed *supra* with respect to independent claims 1 and 4.

CONCLUSION

The references disclose a graphic processing apparatus that includes

> a hidden surface removal and shadowing processing section for obtaining a coordinate region that is positioned behind the front-facing shadow polygons and in front of the back-facing shadow polygons when seen from the visual point based on the visual-point coordinates, the depth values and the Z-buffer memory after hidden surface removal processing by Z-buffer method is performed on the normal polygons, and updating color data on pixels in the pixel memory corresponding to the obtained coordinate region to shadow color data (claim 1).

ORDER

The Examiner's rejection of claims 1-11 is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED

babc

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